CHAPTER 7. HIGH FREQUENCY ASSIGNMENT PROCEDURES

700. GENERAL.

a. HF by definition covers from 3 to 30 MHz. It is that portion of the spectrum that has a world-wide coverage potential, although it is a tenuous one. The availability of signal reception anywhere in the world depends on many conditions. The time of day, time of year, time of the 11-year sunspot cycle, and the frequency itself are all determining factors. Up to 30 MHz or so, the higher the frequency, the further a signal can be received in daytime. But at night, most signals above 15 MHz are lost to space and not returned to earth beyond RLOS. This is due to the nature of the signal as it reflects off one of the various layers of ionosphere from about 50 to around 200 miles above the earth.

b. At night, lacking the sun's heating of the various ionospheric layers, most layers will not reflect the higher frequencies. It is common for HF systems to have "day" and "night" frequency pairs or families. ASR has provided families of five or so frequencies throughout the HF band for specific use by FAA. One circuit might use an 8 MHz frequency nighttime and a 16 MHz frequency daytime to cover the United States coast to coast. These reflective layers, known originally as the Kennelly-Heaviside Layers for their discoverers, are now generally referred to as "ionospheric layers." There are five identified layers that are a consideration in HF radio propagation. See figure 7-1.

(1) The D layer averages 45-55 miles above the earth. Its density, thus its ability to reflect radio signals, varies with the sun's height during the day. The rise and fall of the D layer (sunrise to sunset) determines the lowest usable frequency (LUF) that will support propagation between two selected fixed points at a given time. This layer is most significant below 5 MHz. This layer permits long-distance reception of AM Broadcast stations at night for over 2000 miles or so.

(2) The E layer averages 65-75 miles above the earth. It also is viable only during sunlight, with its greatest usefulness at high noon. This layer effects mid-range HF frequencies.

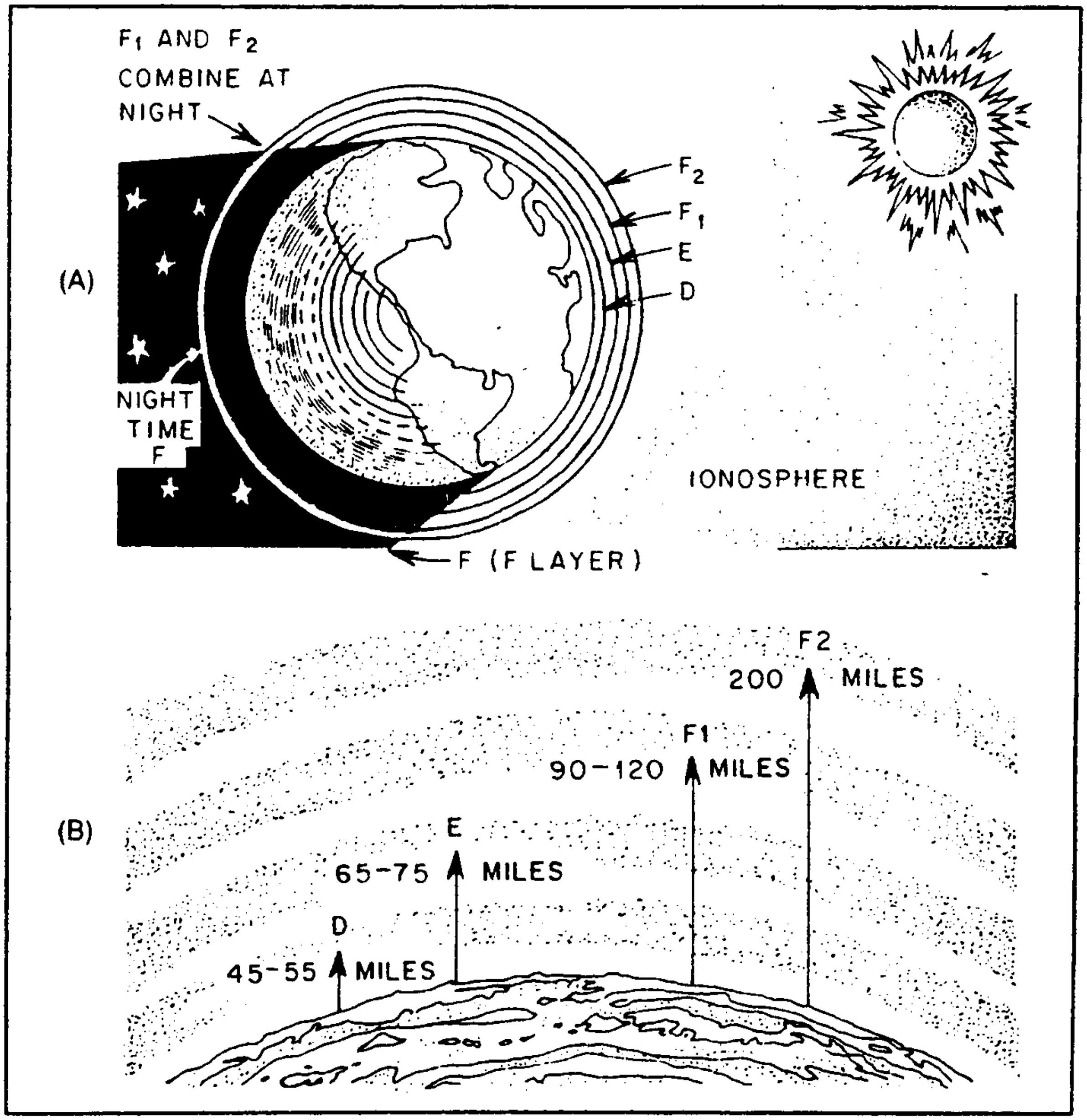
(3) The Es layer, usually called the sporadic-E layer, drifts erratically and unpredictably about 70 miles above the earth. It is significant only for frequencies of 20 MHz or so and higher.

(4) The F1 layer averages 90-120 miles above the earth. It is also dependent upon the sun for its existence. The F1 layer disintegrates and melds with the F2 layer after sunset.

(5) The F2 layer averages around 200 miles and is the most important for long range propagation. It permits reflection of signals which, with the curvature of the earth, can be received for thousands of miles.

c. The term maximum usable frequency (MUF) refers to the highest frequency that will permit satisfactory propagation of radio signals between two fixed points at a given time. MUF varies diurnally, seasonally and with the sunspot cycle. The best HF frequencies which will propagate are between LUF (lowest usable frequency) and MUF. See subparagraphs a. and b., above.

FIGURE 7-1. IONOSPHERIC LAYERS ILLUSTRATED



Courtesy *ARRL Handbook*

d. A very good general description in more detail of the ionospheric layers can be found in the *ARRL Handbook for The Radio Amateur*.

701. INTERNATIONAL HF REQUIREMENTS. The HF services available to support the NAS international requirements are the Aeronautical Mobile (R) and Fixed services.

a. HF Aeronautical Mobile (R) service provides A/G COMM for flights operating in international airspace beyond the VHF range of air traffic control (ATC) ground stations. The A/G COMM in support of the ATC function is provided by Aeronautical Radio, Inc. (ARINC), under contract to FAA. The ground-to-air communications service is a broadcast service, providing meteorological information to enroute aircraft (VOLMET), and is provided by FAA. Frequency assignments are in accordance with ITU Appendix 27, Frequency Allotment Plan for the Aeronautical Mobile (R) Service and Related Information, from those allotted to Major World Air Route Areas (MWARA) and VOLMET, respectively.

b. HF Fixed services were previously provided to satisfy long distance international communications requirements for ATC. However, essentially all such operational requirements for these services are now satisfied by submarine cable or satellite, provided by international communications common carrier and counterpart foreign Postal Telegraph and Telephone Authority (PTTA) through the Defense Commercial Communications Office (DECCO).

702. NATIONAL HF REQUIREMENTS. Additional HF services are required to satisfy national (domestic) requirements.

a. HF Aeronautical Mobile (R) service provides A/G COMM in the State of Alaska via FAA FSS's. Frequency assignments are made in accordance with ITU, Appendix 27 from those allotted to Regional and Domestic Air Route Area (RDARA) and the Annex to the NTIA manual.

b. HF Fixed service provides point-to-point (PTP) COMM primarily in support of RCOM. Frequency assignments in this service are made in accordance with the NTIA Manual, Table of Frequency Allocations. See figure 7-2 for authorized RCOM frequencies. Refer to the individual station's FTA for details of the assignment.

FIGURE 7-2. RCOM FREQUENCIES

CHNL	FREQ (kHz)	NOTES	CHNL	FREQ (kHz)	NOTES
00	4055.0	USB (East. U.S.)	18	15851.0	LSB (West. U.S.)
01	4055.0	LSB (West. U.S.)	19	16348.0	USB; LSB
02	4625.0	USB; LSB	20	19410.0	USB (East. U.S.)
03	5860.0	USB	21	19410.0	LSB (West. U.S.)
04	6870.0	USB (West. U.S.)	22	20852.0	USB; LSB
05	6870.0	LSB (East. U.S.)	23	24550.0	USB (West. U.S.)
06	7475.0	USB; LSB	24	24550.0	LSB (East. U.S.)
07	7611.0	USB (East. U.S.)	none	3428.0	USB: A/G FIFO use
08	7611.0	LSB (West. U.S.)	none	5571.0	USB; A/G FIFO use
09	8125.0	USB (East U.S.)	25	8912.0	USB; A/G FIFO use
10	8125.0	LSB (West. U.S.)	26	11288.0	USB; A/G FIFO use
11	9914.0	USB; LSB	27	13312.0	USB; A/G FIFO use
12	11637.0	USB (East. U.S.)	28	17964.0	USB; A/G FIFO use
13	11637.0	LSB (West. U.S.)	none	2866.0	USB; A/G Alaska only
14	13457.0	USB (West. U.S.)	none	3449.0	USB; A/G Alaska only
15	13457.0	LSB (East. U.S.)	none	8855.0	USB; A/G Alaska only
16	13630.0	USB; LSB	none	11375.0	USB; A/G Alaska only
17	15851.0	USB (East. U.S.)			

NOTES:
1. USB - upper sideband operation
2. LSB - lower sideband operation
3. Eastern U.S. is defined as East of the Mississippi River
4. Western U.S. is defined as West of the Mississippi River

703. HF ENGINEERING. HF frequency engineering is normally accomplished by ASR engineers based on HQ-oriented requirements. Regions may be asked to provide the following information for the NTIA Form 19-A:

a. Station Class (STC)

b. Emission (EMS)

c. Power (PWR)

d. Transmit/Receive State (XSC/RSC)

e. Transmit/Receive Antenna Location (XAL/RAL)

f. Transmit/Receive Antenna Latitude (XLA/RLA)

g. Transmit/Receive Antenna Longitude (XLG/RLG)

h. Transmit/Receive Antenna Dimensions (XAD/RAD - gain only)

i. Transmit Azimuth (XAZ)

j. Authorized Area of Operation (*RAD)

k. Number of Stations and System Name/Identifier (*NRM)

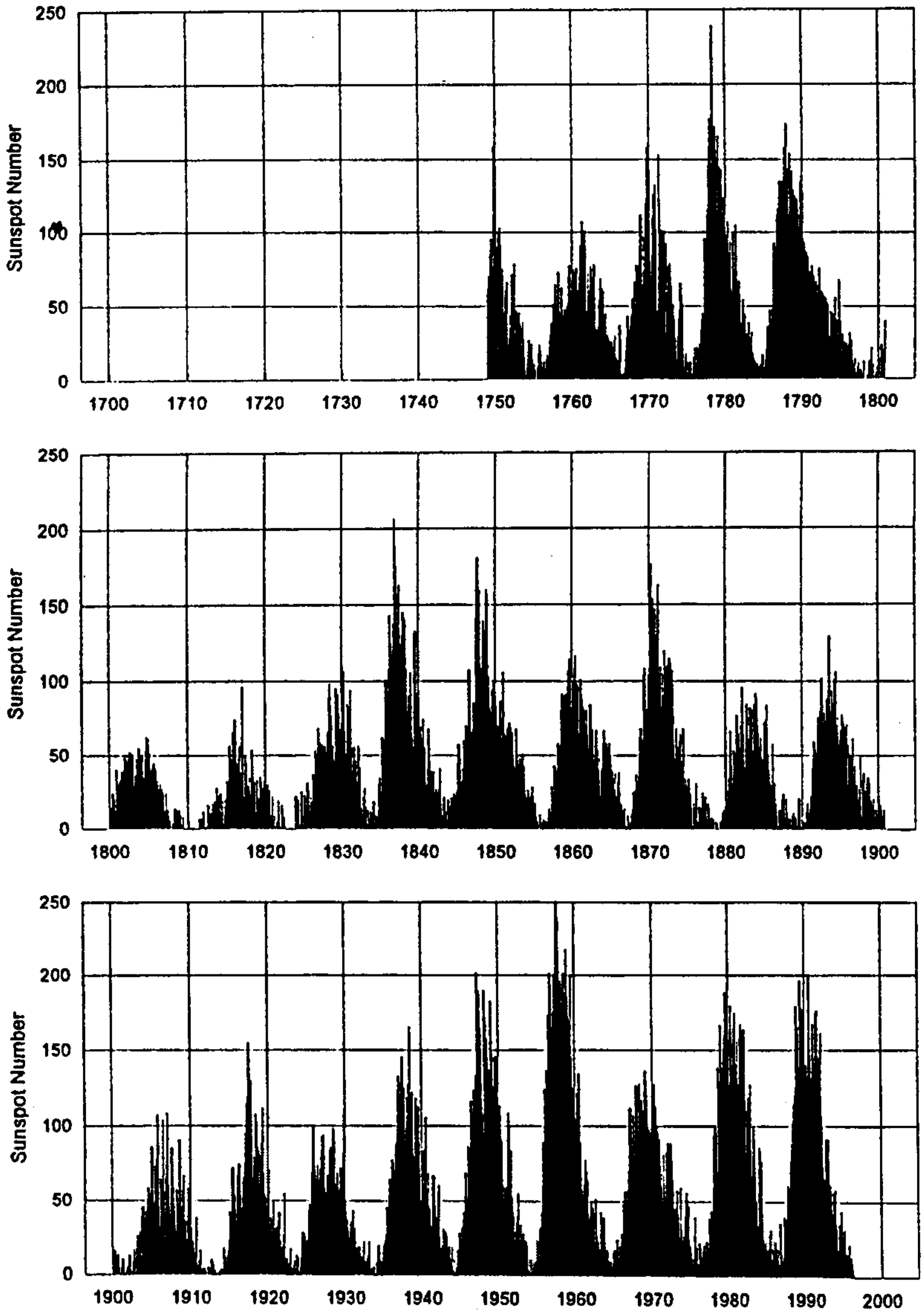
l. FACID Sort (if desired)

m. For Single Sideband Operations, whether upper sideband (USB) or lower sideband (LSB) is required.

704. PROPAGATION AND CIRCUIT RELIABILITY. There are several good computer models which will reasonably predict HF radio signal propagation via ionospheric skywave paths. These models have many parameters, but are mainly predicated on sunspot activity, known and predicted.

705. SUNSPOT NUMBERS. Sunspot numbers are the number of sunspots observed over a specific period of the 11-year cycle. The level of effect is determined by the National Institute of Standards and Technology (NIST) observation group. The HF MUF varies due to many factors (see ¶ 700), including sunspot activity. The more sunspot activity, the more the ionosphere is ionized, the denser the layer and the higher the MUF, the better it reflects HF signals back to earth at great distances. The reverse is also true as MUF's decrease. A plotted graph of observed sunspots for 1749-1996 is shown in figure 7-3.

FIGURE 7-3. MONTHLY SUNSPOT NUMBERS JAN 1749 - APR 1996



National Geophysical Data Center
NOAA, United States Department of Commerce

325 Broadway, Mail Code E/GC2
Boulder, Colorado 80303-3328 USA

706. SOLAR FLARE/STORM REPORTING PROCEDURES. The NIST provides solar flare alerts to FAA through ASR, who in turn, passes them to FMO's. Although the heaviest effect is upon HF, VHF as well as hard-wired data circuits are affected due to the increased earth magnetic currents. The usual VHF effect on COMM is a squelch break, followed by a "hissing" noise.

707. thru 799. RESERVED.